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## Digital empowerment for whom? An analysis of 'Network sovereignty' in low-income, rural communities in Mexico and Tanzania

Lisa Parks<sup>a</sup>, Ramesh Srinivasan<sup>b</sup> and Diego Cerna Aragon <sup>oc</sup>

<sup>a</sup>Global Media Technologies & Cultures Lab, University of California Santa Barbara, Santa Barbara, CA, USA; <sup>b</sup>Department of Information Studies, University of California-Los Angeles, CA, USA; <sup>c</sup>Department of Comparative Media Studies, Massachusetts Institute of Technology

#### ABSTRACT

When researchers invoke the term 'last billion' to refer to emerging ICT users, they often focus on network access as a 'solution' while neglecting important considerations such as local ownership or knowledge, both of which are essential to sustainable and empowering uses of these technologies in developing contexts. Research reveals that mere access to networks without active community involvement can fail to empower already marginalized and disenfranchized users. Building upon these findings, this article uses ethnographic methods to explore the meanings of 'network sovereignty' in rural, low-income communities in developing countries. It presents two case studies focused on local network initiatives in Oaxaca, Mexico and Bunda, Tanzania and then offers an assessment matrix to support future network sovereignty research based on five categories: community engagement; local cultures/ontologies; digital education and technological knowledge; economic ownership; and community empowerment. Our comparative research reveals that communities that are able to assert collective ownership over local infrastructure, embed network initiatives within local cultures, and prioritize digital education are much more likely to create and sustain local networks that support their economic, political, and cultural lives.

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ICT4D; community networks; network sovereignty; infrastructure; local culture

## Introduction

Researchers have described people around the world without internet connectivity as the 'last billion' or 'next billion' (Arora, 2019; Ben David, 2015; Esselaar et al., 2017; Quast, 2016). Despite a plethora of connectivity campaigns led by governmental and private internet service providers, this primarily non-western population remains largely unconnected (Musiani, 2015). Modest revenue streams in low-income communities, sparse populations in rural areas, lack of reliable information about users, paucity of credit assessment mechanisms, and limited complementary infrastructure are perceived as roadblocks in providing service to emerging users. When commentators invoke the

CONTACT Lisa Parks parks@ucsb.edu Department of Film and Media Studies, University of California-Santa Barbara, Santa Barbara, CA 93106-4010, USA

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'last billion' ICT users, they often posit access as a 'solution' while neglecting important considerations such as the knowledge and skills needed to implement, control, and sustain technologies in local communities with diverse geographic, political, and economic conditions. Research reveals that mere access to networks without active community involvement does not empower users who are already marginalized and disenfranchised (Donner, 2015; Hargittai, 2002, 2007). Despite the universalizing metaphors by which many global telecommunication infrastructures are often described (e.g., that our data are preserved and shared via the 'cloud,' or that that electricity is provided via a 'grid'), access to infrastructures by 'last mile' communities is hardly equalizing or 'flattening' (DiMaggio & Hargittai, 2001; Friedman, 2005; Hargittai, 2007; Zillien & Hargittai, 2009). Far more important is the degree to which such communities are able to establish 'network sovereignty' (Duarte, 2017) over technology–learning about, building, operating, and using such systems in ways that support local cultures and ontologies (Star & Ruhleder, 1996).

Scholars have approached digital networks and sovereignty in various ways. Saskia Sassen (2000) has argued that as internet access expanded, nation states relinquished their sovereignty and became increasingly subject to the logic of global capital markets. Financial markets, digitized and globally integrated, now have the power to affect and reorganize existing meanings of sovereignty. Recently, Couture and Toupin (2019) formulated a typology of research on digital technologies and sovereignty based on five categories: cyberspace sovereignty, state sovereignty, social movements sovereignty, indigenous sovereignty, and personal sovereignty. But as Adonis (2019) points out, most research on digital networks and sovereignty focuses on state actors, despite their general failure, along with private telecom corporations, to provide services to low-income rural communities. Amidst these challenges, opportunities for local network sovereignty have taken shape.

The research we present here is inspired by the work of Marisa Duarte whose pathbreaking book, *Network Sovereignty* (2017), reveals how technology initiatives led by Indigenous people can play a transformative role in the reassertion and exercise of their sovereign rights. By approaching network technologies as 'means of working toward decolonization' (2017, p. 25) and building their own broadband infrastructures, Indigenous people articulate and advance their own autonomy and self-determination. Duarte's work evokes key questions around who defines, controls, and/or benefits from local network infrastructure in Indigenous and rural, low-income communities in different parts of the world.

As mentioned above, most literature on digital networks and sovereignty is related to nation-states. Our study extends this research by analyzing the role of non-state actors (Kukutai & Taylor, 2016; Lynch, 2020) and exploring how network sovereignty emerges in community contexts in the global South. It addresses crucial questions including: Who owns and operates digital network facilities in rural, low-income communities? Who in the community understands how these network facilities work and is responsible for repairing and maintaining them? What local training, knowledge, and ontologies emerge in relation to network infrastructures? How are these networks embedded in everyday life? Do community members feel empowered by digital networks? By answering these questions our research illustrates how local communities in developing countries

experience varying degrees of network sovereignty in their everyday life involvements with technologies.

This article offers an ethnographic account of two community-driven projects that attempted to incorporate principles of network sovereignty. Following a case-based logic (Della Porta, 2008), our research offers a description and analysis of a pair of network initiatives in Oaxaca, Mexico and Bunda, Tanzania that share a number of similar characteristics (embeddedness in rural, low-income, culturally diverse settings with limited internet services and varied levels of technical education) with one major contrast: the management of their implementation. Whereas our Oaxacan example was guided by a bottom-up logic, the project in Bunda followed a more top-down process. Our selection of these cases stems from our past research on ICT infrastructures in Central America and Southern Africa, and relationships established over several years with local partners and community members in Mexico and Tanzania. Our collaborators were either involved in or aware of network initiatives in these communities, and facilitated our community engagements.<sup>1</sup> Between 2018 and 2019 we conducted fieldwork and semi-structured interviews with more than thirty community stakeholders and network users in each site.<sup>2</sup> Our partners provided translations from Mije, Mixtec, Zapotec, and Swahili into English. We also visited various technology facilities (server houses; transmission towers; electricity sub-stations, community centers, schools, offices, etc.) to learn about the structure, organization, and labor relations of local networks. We analyzed our ethnographic data from each site and developed a conjunction of thick descriptions that encompasses the communities, the initiatives, and their contexts. While analyzing our data we used invivo coding (Strauss, 1987, p. 28) and isolated local cultural principles, project details, and/or material conditions that were unique to each site and discussed them. Drawing upon ethnographic action research and the idea of communicative ecologies, we also paid attention 'to wider contexts of information and communication flows and channels, formal and informal, technical and social, to understand communication opportunities and barriers' (Tacchi, 2015, p. 220). We then conducted a comparative analysis of data from the two sites, evaluating similarities and differences, and identified several overarching metathemes (Ryan & Bernard, 2003, 99) related to the network initiatives' success or limitation. We used these metathemes to distill an assessment matrix to support future research on local network sovereignty. They include: community engagement; local cultures/ontologies; digital education and technological knowledge; economic ownership; and community empowerment.

# The Telecomunicaciones Indígenas Comunitarias Project and Communalidad, Autonomia, and Ontology in Oaxaca

Rural indigenous Zapotec, Mixtec, and Mije communities of the Southern Mexican state of Oaxaca face challenging conditions for technology implementation. They are surrounded by cloud forests (see Figure 1), constant rains, unreliable electricity, and have limited revenue. Far from being setbacks, these conditions have inspired the design, engineering, and upkeep of the Telecomunicaciones Indígenas Comunitarias (TIC) project. TIC includes over seventy cell phone networks, connected via 19 autonomous towers, independently owned and operated by the region's indigenous Zapotec, Mixtec, and Mije communities. Together these network infrastructures represent the largest

reality.'



Figure 1. Cloud forests surround the Zapotec community of Yaviche. Photo by Ramesh Srinivasan (2018).

community-owned cell phone network in the world. The user communities are located in mountainous, rural areas of the Sierra Juárez, Mixe-Alto, Mixteca, and Sierra Sur regions – several hours from small towns. This territory is home to about one third of Mexico's national Indigenous population, and an estimated 16 Indigenous languages and dozens of dialects.

TIC is an organization based out of the city of Oaxaca, México, and was established in 2012 by a group of hackers, activists, and Indigenous community leaders from the region. Indigenous users serve on the organization's board, directly invest in, and, therefore, own the local networks. Indigenous communities are also physically, economically, and politically responsible for making these infrastructures work.

Unlike 99% of network initiatives across the world, TIC depends on its user communities to lead the effort. Many internet users in the world are accustomed to getting network access from a private corporation or government provider, whose decision-makers remain anonymous, and often thousands of miles away. TIC operates based on the opposite logic: with the help of staff from Oaxaca, community members learn the technical skills to keep the network functional. Together, they make decisions regarding how to invest money and energy into the networks. The network goes as far as its users take it.

In this sense, the TIC is far more sociotechnical than technical: it demonstrates how local communities imagine and apply technology to best support themselves and their interests. Their intimate awareness of place, history, people and culture reveal, according to TIC director Peter Bloom, an American telecommunications activist who has lived in the Oaxaca region for well over 10 years and worked with Indigenous leaders, as to how ' ... there (are) people sitting in Silicon Valley or wherever, thinking up problems, and then thinking up solutions to those problems. But they're not grounded in anyone's

TIC formed, in part, because Mexico's commercial telecom providers had ignored these communities. Why? Because these communities are few in number, poor, and live in rugged environmental conditions. This is why TIC operates based on what its organizers describe as 'human' and 'environmental' scales. Unlike Mexico's commercial

providers such as TelCel or Movistar, TIC is collectively owned and described by local leaders as an expression of their communal practices of living and being. The organization has no profit motive, does not collect intimate personal user data, and rejects money-making calculations in its investments into community cell phone networks. The project's purpose is to support Indigenous and human rights.

In contrast, commercial mobile service providers in Mexico, offer service at rates users can neither control, negotiate, or afford. Rural users may be charged exorbitant rates that are several times higher than their urban counterparts. These profit-driven companies only invest in infrastructure when they can safely predict significant returns. To maximize income, companies seek markets with large numbers of financially secure users. To minimize their costs commercial providers are biased toward infrastructure implementation sites that are uncomplicated.

As TIC is owned and formed by community *asambleas* (assemblies), it follows an economic model of collective ownership in design and implementation. Its 42 Mexican Peso (about \$2 USD) monthly subscription fee program provides users with free network access and much lower long-distance call fees than commercial providers charge, saving users a great deal of money. Instead of an extractive model where subscription and phone call fees are sent to corporations far away, network expenses are paid to the TIC, and funds are re-circulated within local communities so they can hire network administrators, technicians, and pay for electricity.

While traditional telecom businesses ask users to pay for access without decentralizing ownership, TIC's economic model aspires to support community self-determination. Each TIC-community maintains its own cell phone network via local GSM towers. These towers allow for local and regional mobile phone calls, while long-distance calls are made by connecting the local networks to Voice over Internet Protocol (VoIP) technology, which most communities are able to access via local Internet Service Providers (ISPs). The TIC setup allows users to call one another locally and across regions for a fraction of the normal, commercial price.

We note the dependency TIC has on external ISPs, along with the reality that longdistance calls are often routed through US-based data servers. But the TIC offers an economical option as users can call relatives or friends in Los Angeles and the United States for a cheaper rate than those who live in Mexico City. But the situation also reveals how TIC, like many other network initiatives, is not truly autonomous as it depends on external organizations or infrastructure links. In this sense, network sovereignty is an aspirational dimension of TIC that is grounded in local principles of indigenous selfdetermination.

The ethnographic and interview-based data we gathered across these several communities (of Mixtec, Zapotec, or Mije descent) between 2017 and 2019 reveal how TIC's initiatives articulate several key principles: (1) *comunalidad*, or the collective practice by which the network is built and owned; (2) *autonomía*, or the political philosophy of self-determination widely shared across Oaxacan communities; and (3) ontology, or the knowledge practices and voices of user communities that drive TIC leadership.

Indigenous philosophers from Oaxaca, including Jaime Martinez Luna and Floriberto Díaz Gómez, have coined the term, *comunalidad*, to describe the sense of community and interdependence at the heart of life. This is not a sense of individualism or self; rather, as Gustavo Esteva (2012) explains, it is 'about displacing the economy from the center of

social life, reclaiming a communal way of being, encouraging radical pluralism, and advancing towards real democracy' (para. 1).

Far from being an abstract political philosophy, *comunalidad* is activated and demonstrated through the languages and practices of indigenous Mixtec and Zapotec communities. During interviews, we heard this term used alongside other well-known indigenous terms such as: *tequio* (or 'good work'; dignified and good-intentioned work for the community rather than merely for oneself or one's family); and *mancomún*, or the indication that each individual person (or 'man') does work together with others in their community.

Far more than trite slogans, these community-oriented philosophies were evident in the social and political gatherings we were able to observe in the towns and villages we visited. For instance, they were revealed during the collective assemblies during which decisions about the TIC network are made. These noisy, chaotic, yet inclusive and democratic gatherings are made not just by powerful individuals within these communities, but nearly everyone.

The second principle related to network sovereignty that emerged during fieldwork is *autonomía*. This concept is related to *comunalidad*, but refers more to matters of local empowerment and what community members, in interviews, described as 'collective determination.' This involves the shifting of power into the hands of communities rather than to a collection of individuals or elites. As the ownership of the network lay in the hands of every community member; no one had greater equity in TIC and no one had less.

As an Indigenous leader in the TIC-leading Mixtec community of Nuyoo (see Figure 2) explained, 'My community is my root, my whole self. It is to take care of what I have so I can pass it to future generations. It is a feeling. Community and autonomy is to value who I am.' The vital interconnections of comunalidad and autonomy are



Figure 2. View of the Mixtec community of Nuyoo. Photo by Ramesh Srinivasan (2018).

also embedded in historical experiences. '*Autonomía*,' has important meaning in Oaxacan political philosophy and is commonly used by activists and rural community members to describe their attempts to maintain distinct cultural, political, and economic visions despite a long history of colonization.

Indigenous community members we interviewed described autonomy, sovereignty, and ownership as values to pursue not merely via the TIC network itself, but also via other related technology initiatives. For instance, one Zapotec community-leader, inspired by TIC, established a local university, 'Xhidza,' that teaches digital literacy and design based on the perspectives, values, and cultures of Zapotec peoples. TIC communities are also attempting to take power over other infrastructures that the phone network relies upon, for example by developing solar, wind, and other renewable energy sources (Figure 3).

Another goal is to make the TIC system more accessible, open, and modifiable by its users. As a network administrator in Yaviche explained

It is necessary to form technical teams who are knowledgeable about how the equipment / infrastructure works. To offer those capacities to our youth or community members. The other thing is to bring together all the different phone technologies – to establish an intranet,



**Figure 3.** Poster with instructions about TIC placed in Oaxacan communities. Photo by Ramesh Srinivasan (2018).

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have digital libraries, and for all to be in one single machine, so we can access everything in a more classified way according to our communities' interests.

The third principle that arose from our fieldwork speaks to the power of local cultures, knowledges, and lifeways in directing TIC network initiatives. We characterize this imprinting of local knowledge and aspiration onto the network as ontology. While *comunalidad*, involves collective participation, and *autonomia* evokes local power and ownership, ontology speaks to the way Indigenous cultural practices or rituals, languages, metaphors, and/or meanings guide the network initiative. From giving the network local Indigenous names to using the network to inspire greater communication orally (and through text) of Indigenous languages, TIC has been wielded as a technology in solidarity with Indigenous beliefs, languages, and values. Fieldwork revealed how a 'new' technology can support rather than diminish Indigenous traditions, long suppressed and cast as anti-modern by the Spanish, and later the Mexican nation-state. As one Mixtec leader told us, 'As long as we are not part of the technology, of that knowledge, we continue to be exploited by technology.' This comment speaks to why local ontologies are so central to all that TIC represents symbolically and in practice.

This ethic, which contrasts a corporate logic that guides technology with community voices and cultural diversity is noteworthy. Designing, owning, managing, localizing, and taking power over mobile technology are complicated tasks, but dozens of Indigenous communities in Southern Mexico, in tandem with their hacker and activist partners, have already taken the leap, in the process embarking upon a journey of exploration outside of the producer-consumer relationship. TIC reveals that the future of technology design and implementation can indeed be driven by the aspirations and values of Indigenous and global South communities.

Our research from Oaxaca reveals that access to the internet or a mobile phone network alone is not empowering in itself, as the question will always remain: access to what? By exploring TIC's connection to the themes of *comunalidad*, *autonomia*, and ontology, we were able to observe experiments of network sovereignty in action. But such experiments cannot be looked at in a vacuum. Indeed, numerous dependencies and challenges have complicated the ability for TIC to scale to other communities and sustain itself. Every Indigenous community we visited, despite the project's approval via the collective asamblea, held internal divisions, as the project was often led and carried out by specific families. As a result, those driving the network's implementation and, in a material sense, enabling the project's aspirations and visions (how it would grow, how it would be best monetized, who to employ, and who to represent it to the wider world) were but a small subset of the overall community.

In addition, we note the profound dependencies that TIC has had on the Mexican state. Due to an amicable relationship with the national Ministry of Telecommunications – a co-founder of TIC is a former ministry employee – TIC has been able to clear regulatory hurdles quite easily, and has benefitted from ministry resources. The state has promised allocation of satellite bandwidth to support TIC's expansion and incorporation of mobile data and internet connectivity, and has provided TIC with basic funds on a discretionary basis. As history has shown the Mexican state has not always been an ally of Indigenous movements toward sovereignty and autonomy, so this collaboration is a precarious one. Just as the infrastructure of a cell phone network relies upon others

such as electricity, so too do the political and economic dimensions of network sovereignty in Oaxaca rely upon local, regional, and federal relations and coordination.

The TIC story and its Indigenous technology innovators teach us that the end game is never just about establishing a network. It is about the voices and agendas that drive its creation and the social worlds the technology fuels and facilitates. We observed several communities leveraging their network to support a community-based intranet (for digital communications, texting, and data-sharing), a digital library for cultural and educational resources, and technological training of community members. These examples revealed that many TIC communities are tapping into their greatest resource: people, their knowledge and traditions, and their aspirations and goals. These will all need to continue to be harnessed to fight off the many threats to sustainability and growth faced by this bottom-up network sovereignty initiative.

### ICT4RD Network Initiatives in Bunda, Tanzania and Infrastructural Inertia

While the TIC case study focuses on communities that successfully established local networks based upon Mixtec and Zapotec principles in a bottom-up, community-driven manner, our fieldwork in Bunda, an administrative district and town in the Mara region of Tanzania, revealed quite different conditions. Bunda sits northwest of the Serengeti National park and east of Lake Victoria. This agricultural community is home to 335,000+ residents, two thirds of whom live below the national basic needs poverty line.<sup>3</sup> Most Bundans speak Swahili, Tanzania's primary national language. Indigenous languages, including Ikizu, Jita, Kwaya, Sizaki, are also spoken in the region. Since Bunda sits along the north–south transnational highway, the town serves as a hub for more than 100 villages and hosts a public market (see Figure 4) where electronics, clothing, furniture, energy and farming equipment, fresh produce, and other goods are sold.



Figure 4. Scene of the public market in Bunda. Photo by Lisa Parks (2018).

The community has a district hospital, primary and secondary schools, small restaurants, mobile phone offices, and a radio station.

In 2005 the Bunda district ICT office (see Figure 5) partnered in an initiative called ICT for Rural Development (ICT4RD) in an effort to build community internet services. This international collaboration with researchers from the Dar es Salaam Institute of Technology (DIT), Sweden's Royal Institute of Technology (KTH), and the Tanzania Commission for Science and Technology (COSTECH) set out to help establish sustainable broadband markets in rural Tanzania.

Bunda's first ICT4RD project – the Serengeti Broadband Network (SBN) – was funded by the Swedish International Development Agency (SIDA).<sup>4</sup> Launched in 2007, the SBN established a fibre optic link between Bunda and Mugumu, a community 140 kilometers to the east, and created the possibility of wireless area networks (WLAN) off the main line. Guided by principles of local network sovereignty, the project's academic researchers sought to work with community leaders to build a network that would 'create ownership at the ground level,' 'facilitate creation and sharing of information at government institutions,' and provide internet 'to individuals and private companies in the area to strengthen local ownership as well as share bandwidth costs' (Nungu et al., 2008). More generally, ICT4RD set out to support community autonomy by establishing 'self-sustained local area broadband islands serving local communication needs, even if there are currently no, or only narrowband, external connections due to the unavailability or too high price of uplinks' (Nungu & Pehrson, 2011, p. 169). Such broadband islands would span the entire community and provide access to network services such as VVoIP, email, and internet browsing (Terzoli et al., 2017).

The SBN became operational in 2009 and successfully functioned for over a year. The project's leaders formed an ICT Board in Bunda, registered it as a non-profit company, and secured participation from members of the district government, private sector, and



Figure 5. View of Bunda District ICT office. Photo by Lisa Parks (2018).

community. At its peak, the network served about 100 users primarily based at district offices, schools, NGOs, health facilities, and a handful of small businesses. SBN organizers charged \$45 per month per computer (Nungu et al., 2011) for network use, a high fee relative to local household incomes, approximately \$136 a month.<sup>5</sup> In 2010 there were 27 clients in Bunda and 18 in Mugumu (Holmgren, 2011, p. 17), but over time a series of challenges – including personnel shortages, equipment malfunctions, and funding limits – made the network unsustainable.

When we visited Bunda in 2018, nearly ten years after this network's installation, we found the SBN equipment, cables, and server boxes in disarray in a dusty corner of the community's TANESCO sub-station (see Figure 6). An interviewee, who had been involved in developing the network, showed us the equipment and expressed disappointment and frustration at it 'just sitting there.' He had hoped the effort put into the project would have resulted in a longer-lasting network, and perceived limited funding as the cause of its disruption as well as growing competition from commercial mobile providers.

Other interviewees in Bunda claimed that the SBN had failed because it had been locally mismanaged and questioned the viability of a community-owned network in Bunda. One person who had used the network off and on insisted the problem with



Figure 6. Unused SBN equipment at the electrical sub-station in Bunda. Photo by Lisa Parks (2018).

the network was a 'management thing' involving 'accountability issues' and 'confusion around ownership.' Such comments suggest the importance of attending to the nuances of local politics and economics in efforts to build network sovereignty from the ground up.

While network sovereignty principles – including local ownership, sharing of local information, and cultivation of community stakeholders – guided the SBN's development, the project met various constraints. Discussion of these constraints arose not only during interviews, but was documented by researchers who built the network as well. For example, network installers experienced challenges finding appropriate sites for equipment given a lack of buildings and access to electricity along the route from Bunda to Mugumu. This meant much of the equipment had to be located outdoors, exposed to 'rain, dust, insects, and vandalism' (Nungu et al., 2008, p. 39), and as a result would not last as long.

Project leaders also noted a 'shortage of local human resources,' and sought to address this with IT workshops and training. Yet such training was challenging given that most schools in the area lacked computers and electricity, and many still did as of 2018. One SBN assessment pointed out that very few Bundans were familiar at all with computers or the internet. When community members became involved, they had a great deal to learn about the system's design and operation. As the assessment explained

... most importantly the technicians need to be trained. The local technicians have no or very limited experience ... and need to be trained to independently adapt the configuration to changing demands on the caching server and proxy. Currently, they only have manuals but they do not know how to use them properly' (Holmgren, 2011, p. 23)

While this statement is embedded with assumptions about 'proper' technical training, like our examples from Oaxaca, the situation points to the importance of local knowledge as a dimension of network sovereignty. Local ownership not only involves economic control; it also entails the production of technological knowledge/power that occurs when local cultures merge with embodied processes of siting, installing, experimenting with, using, sharing, and maintaining/repairing network infrastructure. As emphasized in the previous section, community ICT knowledge does not always conform with outsiders' views, understandings, and expectations. Rather, it may take the form of a local ontology – a way of defining and understanding ICTs that is entangled with local languages, cultures, and historical experiences and may be inaccessible or unintelligible to or unintended for those outside the community.

What Bundans 'knew' about ICTs may not have aligned with outsiders' definitions of 'IT expertise.' But it did include layers of consciousness and experience related to the process of negotiating an emergent technology that was unfamiliar to many in the community, and formulating ways of engaging with and understanding it. Even after mobile internet was available in the community, a survey indicated Bundans still preferred to share information via radio, leaflets, posters and word of mouth at schools and markets (ESRF, 2013). As mobile phone use increased and smartphones became available, several interviewees indicated they preferred low-cost feature phones or models with built-in flashlights and radio receivers (see Figure 7) because they were more durable and better suited to farming practices. For Bundans' then, network sovereignty involved the continuity of pre-digital forms of information sharing and use of mobile devices conducive to agricultural work.



Figure 7. Feature phones are preferred by many Bundans due to their lower cost, longer battery lives, and embedded flashlights used in farming. Photo by Lisa Parks (2018).

Despite the challenges with the SBN, the Bunda district participated in another ICT4RD network initiative in 2014. This one involved a partnership with researchers from Germany's Fraunhofer Institute for Applied Information Technology (FIT) and DIT, and the UN Development Programme (UNDP), among others. This initiative set out to provide internet links to four Agriculture Information Resource Centers (AIRCs) in villages along the western side of the Bunda district. The 'UNDP network,' as it was known, was intended 'to provide rural people with easy, cheap access and reliable connectivity, jobs for young entrepreneurs, easy resource sharing etc' (UNDP, 2014, p. 1). Interviewees indicated they also hoped this network would connect schools to the internet.

The UNDP network stretched from the Bunda TANESCO station to Kisorya, 83 km to the west. According to the project map, towers were installed near AIRCs in Mugeta, Bunda town, Kibara, and Kisorya, and near a school in Guta and hospital in Kibara. The network relied on Wireless Backhaul (WiBack) technology, which FIT deployed to 'connect the unconnected' and provide an 'inclusive innovation' solution that brings broadband connectivity into rural areas with good performance at lower costs'. FIT highlights the 'ease of deployment, operation, and maintenance' of its WiBack systems,

making this technology seem an appealing solution after the SBN challenges (Fraunhofer Institute of Technology, n.d.).

Despite this, months after the network's installation, community members were not able to use the network, according to interviewees. One interviewee indicated the high cost of maintaining batteries 'turned the network into a mess.' The batteries that powered the towers depleted rapidly and the community could not afford the \$250,000–300,000 shillings (\$110–132 USD) required to replace them. This created a situation in which UNDP towers loomed over villages, but were useless. When we visited four of the UNDP towers in 2018, they were still standing, but not functioning. As one of the network developers stated, 'I don't feel good when I see all of this infrastructure and the cost. I'd like to see them [the towers] working.'

In a survey conducted a year before the UNDP network's installation, respondents identified various obstacles to information sharing including costs, limited road infrastructure, perceived lack of transparency by those running ICTs, limited time, and local conflicts of interest among village leaders (ESRF, 2013, p. 53). It is not clear whether or how project leaders tried to mitigate or resolve these concerns as they deployed the UNDP network. While community members in Oaxaca were at the table to address such concerns related to TIC, most Bundans were not involved in the UNDP network and thus were not prepared to address these costs and malfunctions.

For example, in Guta village a tower was installed 100 yards from a primary school so the school could be connected to the internet (see Figure 8), but this never happened. The tower's battery died shortly after its installation, and there was no community funding to replace it. Thus, the tower and equipment sat unused right next to the school for several years. One interviewee indicated he was extremely proud to have helped install the tower, and learned a great deal about IT in the process. Yet he felt very frustrated to see that it



Figure 8. Unused UNDP tower near Guta primary school. Photo by Lisa Parks (2018).

was still not working and not serving the school or students. He also mentioned the school lacked computers and electricity, suggesting there had been no comprehensive plan or feasibility study to actually connect the tower to the school.

Near Kibara village, a UNDP tower was installed on a hillside. Shortly after it was mounted, two commercial mobile providers – Halotel and Vodacom – situated new masts right next to it (see Figure 9), and began offering mobile internet services. Community members found the mobile internet services costly, but more reliable, particularly since the UNDP tower sat unconnected to the internet, according to interviewees. Thus, even though the equipment was available to support a low-cost internet service in the village, community members ended up paying commercial providers such as Airtel, Vodacom, Halotel, Tigo, or Zantel and not benefitting from the UNDP network.

Before arriving in Bunda we had read about the community's local network initiatives and assumed they had generated a sense of empowerment among community members. Yet after site visits and interviews, we found quite the opposite to be true. Low levels of community engagement, limited energy supply, funding shortages, and lack of ICT education/training meant the networks failed to empower most community members. The Bundans we interviewed expressed contradictory feelings of excitement and disenchantment, hope and disappointment, and appeared somewhat miffed by the local ICT4RD networks. There was a feeling that the SBN and UNDP networks had served a handful of users in the community for a short amount of time, long enough for researchers to claim a technical demonstration had occurred. Missing in Bunda was a sense of broad community engagement, knowledge, or autonomy, as in the case of Oaxaca with TIC.

While TIC was undergirded by principles of *comunalidad* and *autonomia*, and local ontology, conditions in Bunda bring to life a parallel concept of *infrastructural inertia* 



**Figure 9.** Towers of commercial mobile providers installed by a UNDP tower near Kibara. Photo by Lisa Parks (2018).

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- a material and affective condition that emerges when network technology has been funded, installed, and rendered operational, only to be abandoned and unused once it becomes dysfunctional, whether due to depleted batteries, lightning strikes, or other types of malfunction. This un-use or inertia may be related to limited financing or technical training, or to local cultural disinterest or de-prioritization. Infrastructural inertia not only results in changes to the material environment (e.g., the presence of unused towers and equipment along the landscape); it also affects the feelings of people living in the network's vicinity. When people encounter unused towers daily, the equipment comes to symbolize unrealized potential, failed investments, and broken promises rather than serve as a community network that inspires and empowers people. Moreover, these non-working towers can end up shaping how people feel about the internet, ICTs, and technology more generally. Rather than imagine network infrastructures as sites of local control and potential, feelings of mistrust, reticence, and skepticism can set in given the equipment's long-term, non-working presence.

### **Matrix for Assessing Local Network Sovereignty**

Our findings from Oaxaca and Bunda reveal how the implementation and impact of a local network initiative are intimately tied to questions of sovereignty and power within communities. Our discussions with interviewees in Mexico and Tanzania suggested the need to both localize and expand the conceptualization of network sovereignty as a spectrum of possible experiences, and to consider varying degrees of (1) community engagement; (2) local cultures/ontologies; (3) digital education and technological knowledge/power; (4) economic ownership; and (5) community empowerment that people experience in relation to ICT networks in their vicinity. Our comparative findings reveal that there are no 'perfect solutions' with regard to building local network sovereignty, yet these five categories emerged as important factors in discussion of our case studies. We present overviews of these categories below as well as a Local Network Sovereignty Assessment Matrix (see Figure 10), which we hope will inspire future research.

#### **Community engagement**

Our fieldwork suggests that direct involvement and participation of a broad base of community members is vital to the sustainability of local network initiatives. Our case studies showed strong involvement of Oaxacan communities in TIC decision-making processes and use. In Bunda, however, most community members were not included in discussions about the ICT4RD network and hence their engagement was quite limited. When assessing the degree of community engagement it is important to consider who in the community leads the network initiative, whether ongoing input from community members is solicited, and whether involvement is encouraged across demographics of gender, age, race/ethnicity, geography, occupation, and education level. Is the network led by outside researchers, a selected family, local government, or community group? If it is a subset of the community, does that subgroup speak to and for the larger community? What actions are taken to ensure a broad cross-section of community members can get involved in or benefit from the network? If people are recognized as being left out of the process what is done to remedy this exclusion?

Local Network Sovereignty Assessment Matrix	
Category	Scale 1-10
Community Engagement Was a broad cross-section of community members consulted before, during and after the network began? Who in the community leads the network initiative? Does this entity have broad community support and trust? Have community members across demographics of gender, age, race/ethnicity, geography, occupation, and education levels had opportunities to be involved in network development, operation, and use?	Limited Extensive
Local Cultures & Ontologies Is the network grounded in local histories, cultures, and experiences? Is the network defined, discussed, and deliberated in local languages? Do community members use the network to share community-based information, stories, and expressions? Is the network perceived locally as enriching or eroding local cultural practices, ruining or renewing them?	Not embedded Embedded 1 10
Economic Ownership Is the network owned locally by community members or by outsiders? Is ownership collective or by a select few? Does ownership result in control over network design, decision-making and administration? Are plans for financial sustainability of the network in place? Or is it a short-term experiment? Were concerted actions taken to ensure broad community involvement in the network? What were they?	External Community-based
<b>Digital Education &amp; Technological Knowledge/Power</b> Do community members show curiosity, interest, and enthusiasm when it comes to learning about ICTs and networks? Do people have equal opportunities to learn about ICTs in schools or other venues? Are only a few people in the community known as ICT experts? Or many? Do people attempt repairs of ICTs when they fail? Are resources available to support repair and maintenance?	De-prioritized Prioritized
Community Empowerment Is the network initiative articulated with local struggles for autonomy? Does the network generate vital services or revenue for the community? Does the network gainfully or meaningfully employ a substantial number of community members? Is the network used widely by community members? Is the network as ite of ongoing community education, learning, knowledge, creativity, and innovation? Is the network perceived locally as a source of empowerment and pride?	Minimal Maximum 1 10

Figure 10. Local Network Sovereignty Assessment Matrix.

#### Local cultures/ontologies

Our fieldwork reveals how the values and belief systems or 'local cultures' of communities, including the ontologies by which people express their relationships to one another and the lands they live upon, can shape and inform how a network is made sense of and understood. While the TIC, as already suggested, can be understood as an extension of local Mixtec and Zapotec cultures, the ICT4RD process did not appear to prioritize local cultures and ontologies of the Mara region. To assess the extent to which a network is grounded in local histories, cultures, and experiences, one must ask: Does the network tend to enrich or erode local cultural practices, ruin or renew them? What cultural barriers, taboos or other obstacles to network use exist? What actions have been taken to embed the network infrastructure and its everyday operation within local cultures? Actions might include everything from naming of the network to painting symbols on server houses to hiring of cultural leaders to communicate about and operate the network.

### Digital education and technological knowledge/power

Local network initiatives are intimately tied to the education, skills, and training of community members. In some cases, community education is a substantial dimension of a network initiative. In other cases, it is sidestepped and external technical experts arrive to design, install, and maintain the system. In Oaxaca, we witnessed digital education as a priority in the TIC's development; whereas, in Bunda, the ICT4RD networks were led largely by those who already possessed technical knowledge. When thinking about local network sovereignty one could ask: Do community members show curiosity, interest, and enthusiasm when it comes to learning about ICTs and networks? How do they acquire technological knowledge, and is that knowledge valued? Do community members have the technological expertise to support the network without external assistance? It is important to remember that digital education not only involves learning how to use software, browsers, and apps at a desktop computer or mobile interface; it also includes awareness of the network's physical infrastructure - understanding its various components and their functions, as well as their location in the community. This understanding enables communities to participate in network maintenance, repair, and upgrade (Jackson, 2015) and grasp its reliance on other infrastructures, particularly energy and transportation.

#### **Economic ownership**

Local network initiatives involve issues of financing, investment, and ownership. Our fieldwork revealed different ownership models are put in place to support network initiatives, ranging from collectives to nonprofits to privatized businesses. The economic sustainability of a network is crucial to community empowerment. Thus, in assessing network sovereignty, it is important to consider whether local network infrastructure is funded and owned by a local entity in the community, a state agency, international non-profit organization, private company, or some combination thereof. Does local economic ownership result in political control over the network? Or does an entity elsewhere administer network operations? Who is responsible for funding and sustaining the network over time? These kinds of questions emerge when considering the relationship between economic ownership and network sovereignty. Our fieldwork suggests that network sovereignty emerges most prominently when communities obtain and assert the power to fund, own, operate, and sustain local networks.

#### **Community empowerment**

We have discussed how community networks may be articulated with local ontologies and values related to autonomy, collectivity, and 'good work.' But our two very different case studies also demonstrate that local networks can empower and disempower. Given this, it is vital to investigate whether a community network is perceived and experienced as empowering among community members and users, and, if so, how, and if not, why not? We learned from the Oaxaca case study that the TIC facilitated community explorations into energy sources, employment, language revitalization, and political decision-making in ways that supported and enriched user communities. In Bunda, experiences of community empowerment were more ephemeral and affected those directly involved in developing or using the SBN and UNDP networks. Our fieldwork reveals broad community engagement at the outset of a network initiative can lead to successful network operations over time. This capacity to build and sustain a useful network can generate feelings of community empowerment that are crucial to the formation of local network sovereignty.

#### Conclusion

Our collaboration across Bunda and Oaxaca reveals the diverse ways local communities in different parts of the world think about, experience, complicate, and/or contribute to understandings of 'network sovereignty,' a concept previously studied primarily within developed countries. Because TIC is run by Mije, Mixtec, and Zapotec communities, who made financial, technical, and political commitments, the network became an expression of and a catalyst for local culture and governance. Mobilizing principles of comunalidad, autonomia, and ontology, Oaxacan communities embraced and laid claim to TIC. Their collective sociotechnical agency gives new life and definition to 'network sovereignty.' In Bunda, the ICT4RD projects, guided initially by principles of community empowerment, were largely led by outside researchers and agencies, involving only a small number of Bundans. Moreover, the networks were relatively expensive to use and maintain, were not embedded within local cultures, and became difficult to sustain. This meant that the ICT4RD networks largely functioned as short-term experiments rather than as expressions of network sovereignty. Towers and other equipment remained in the community, but infrastructural inertia set in with the ICT4RD equipment, leaving most Bundans to turn to commercial mobile phone services.

Rather than rely on state-based frameworks for understanding ICTs, we have foregrounded what we learned through active-listening and participation observation via community-based interviews and site visits, sharing experiences and perspectives of people from Oaxaca and Bunda. Our intention is not to criticize existing network initiatives or leaders/scholars involved in them; rather, to assess the ongoing impacts of these networks and derive considerations for more empowering and sustainable communitybased networks in the future. Like Donner (2015), we want to complicate the tendency in ICTD research to equate network access itself with 'success,' 'development,' or 'achievement,' and push the conceptualization and analysis of network sovereignty to more deeply align with community empowerment. The process of building local knowledge and capacity to support network sovereignty in communities is complex and challenging. Our fieldwork reveals that the communities that are able to assert collective ownership, embed local network initiatives within local cultures/ontologies, and prioritize digital education are much more likely to create and sustain digital networks that support their economic, political, and cultural lives.

#### Notes

- 1. We thank Peter Bloom and Dr. Joseph Matiko and community members of Oaxaca and Bunda for their key insights and assistance with this research.
- 2. We anonymized interviewees' names throughout the article to conform with informed consent protocols. Author 1 conducted interviews in Bunda and Author 2 conducted interviews in Oaxaca.
- 3. This figure is based on Tanzania's 2012 census (National Bureau of Statistics, 2016).
- 4. At the level of \$388,394 USD from 2006 to 2010 (Openaid, n.d.).
- The 2011/12 Household Budget Survey indicates rural Tanzanian households spent on average 212,600 shillings monthly (\$136 USD). The mainland average was 258,751 shillings (\$166 USD) (National Bureau of Statistics, 2014).

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#### **Notes on contributors**

*Lisa Parks* is Distinguished Professor and Director of the Global Media Technologies and Cultures Lab at University of California-Santa Barbara [email: parks@ucsb.edu].

Ramesh Srinivasan is Professor of Information Studies at UCLA [email: srinivasan@ucla.edu].

*Diego Cerna Aragon* is a master's student in Comparative Media Studies at Massachusetts Institute of Technology [email: dcernaa@mit.edu].

#### ORCID

Diego Cerna Aragon D http://orcid.org/0000-0002-3345-6974

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